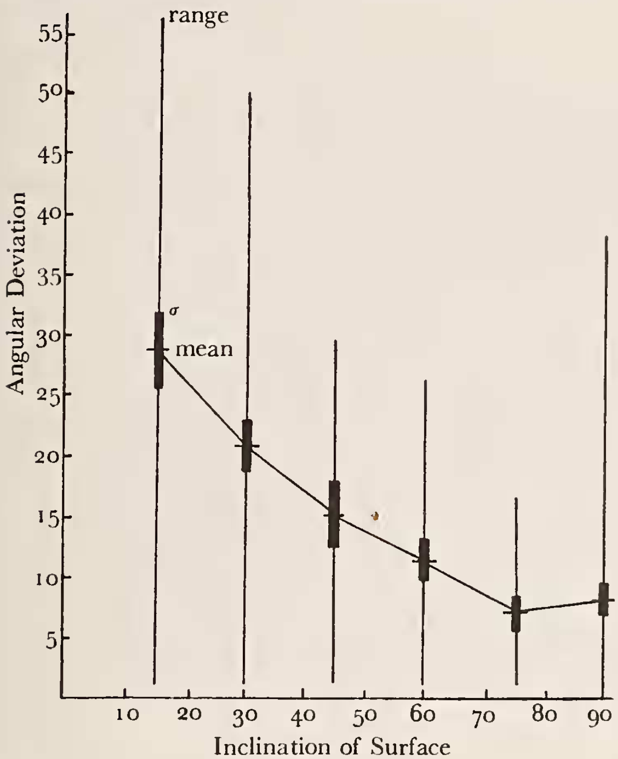

Figure 2: Mean angular deviation, standard deviation and range of each set of angular deviations at each angle of inclination of the surface. At each inclination of the surface the vertical line indicates the total range of the angular deviations; the broad portion of the line indicates the standard deviation on each side of the mean; and the crossbar, the mean.

Figure 3, in which the degree of accuracy has been plotted against the angle that the surface was inclined, shows, in graphic form, the relation between the degree of accuracy of orientation and the angle of inclination of the surface.

Discussion

When accuracy of geotactic orientation is determined by the equation $a - \omega$, the orientation of Helix aspersa has been found to be consistently accurate if progression of the animal takes place on a surface inclined between the angles of 15° and 75° from the horizontal; but on a surface inclined at an angle of 90° from the horizontal, the orientation of this snail is relatively inaccurate. These results tend to disagree with those of earlier workers who found that orientational accuracy of various animals decreased in direct proportion to log sin a or to sin a when accuracy was determined in terms of the magnitude of the probable error of each animal's angle of orientation (Crozier and Pincus, 1927).

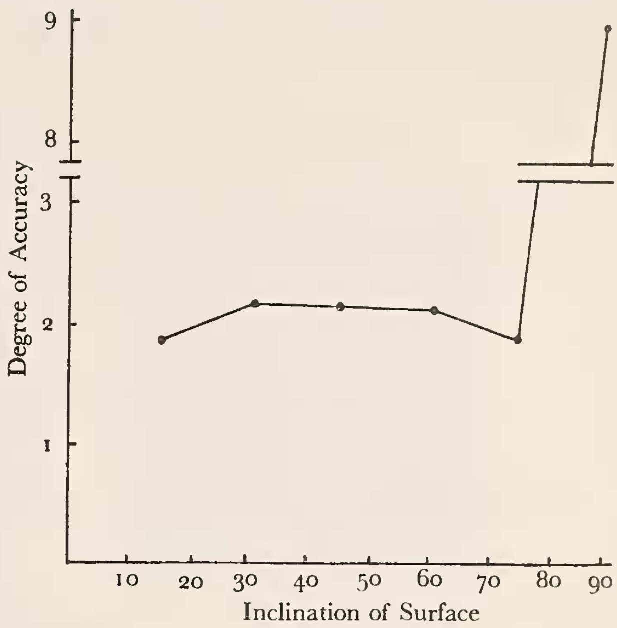

Figure 3: Degree of accuracy at each inclination of the surface.

The snail's true orientation path is a function of the snail's angular deviation at a given angle of inclination of the surface. The degree of accuracy is a function of the snail's true orientation path; therefore, these equations, $a - \omega$ = degree of accuracy, and $\sin \omega = \sin a \cos B$, can validly be used to determine the accuracy of a snail's geotactic orientation. The degree of geotactic accuracy measures a snail's response to gravity.

Summary

The geotactic accuracy of 700 specimens of the pulmonate snail, Helix aspersa Müller, was determined. One hundred determinations were made at each of the following angles: 0°, 15°, 30°, 45°, 60°, 75°, and 90°. Geotactic accuracy was determined by the equation: $a - \omega$ = degree of accuracy, where a is the angle of inclination of the surface and ω is the angle between the snail's true orientation path and the horizontal. ω, in turn, was derived by the equation: $\sin \omega = \sin a \cos B$, where B is the mean of the angular deviations.

Geotactic accuracy had a value of about 2° when a snail was orienting upon a surface inclined between the angles of 15° and 75° to the horizontal but had a value of 8° 53' on a vertical surface.

Acknowledgment

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Observations on Three Species of *Vexillum* (Gastropoda)

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(Plates 41 to 44; 2 Textfigures)

It is a truism that with only a few specimens from a given area, separate species may be easily recognized, but with additional material the lines of definition become less distinct and the supposedly separable "species" appear less so. This basic maxim of conchologists has again proved itself in the case of three mitrid forms all taken at one time in Philippine fishing trawl-nets. The three "separate species" recently collected in a series of five trawled specimens were described as from widely separated type localities (see map, Textfigure 1) and have heretofore been considered distinct.

Mr. Fernando Dayrit of Manila has from time to time sent me material for identification. About a year ago I published an illustrated note (The Veliger, 3(4): 105-107) on a form that I determined as Vexillum utravis (Melvill, 1925). Soon thereafter, two additional forms were collected and sent to me that I tentatively identified as V. formosense (Sowerby, 1890) and V. minahassae (Schepman, 1907), respectively. The determination of V. minahassae was based in part on the original description and type figure and in part on a subsequent illustration and discussion of the species (Schepman, 1911). (Later in the course of the present study, Miss G. E. de Groot of the Rijksmuseum van Geologie en Mineralogie in Leiden kindly furnished photographs of the holotype, which are reproduced here on Plate 41.) In the case of V. formosense, the identification was made not only from the original description and figure but also by a direct comparison (August 1961) with five specimens from the type locality of that species in the collection of the Academy of Natural Sciences of Philadelphia (ANSP No. 251122. Anpin,

Explanation of Plate 41

Figure 1: Typefigure of *Vexillum formosense* (Sowerby, 1890) (x 1.5)
Figure 2: Holotype of *Vexillum utravis* (Melvill, 1925) (x 1.5) Photo, courtesy of National Museum of Wales.
Figure 3: Holotype of *Vexillum minahassae* (Schepman, 1907) (x 3) Photo, courtesy of Rijksmuseum van Geologie en Mineralogie.
Figure 4: Subfossil specimen of *Vexillum minahassae* (Schepman, 1907) dredged in 15 fathoms, Arafura Sea (Siboga Expedition). (x 1.5) Photo, courtesy of Zoological Museum of Amsterdam.

Figure 1

Figure 2

Figure 3

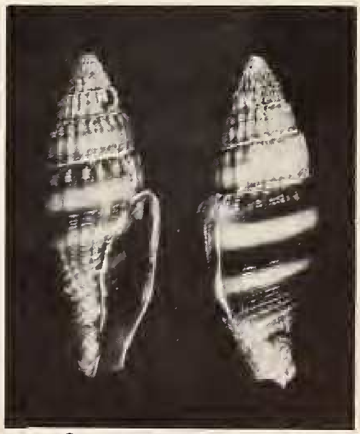

Figure 4